Technical Support Document
for the
Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone
(Clean Air Interstate Rule):
Reconsideration Notice of Proposed Rule

CAIR Statewide NOx Budgets Calculations

EPA Docket number: OAR-2003-0053
December 2005

U.S. Environmental Protection Agency
Office of Air and Radiation

Introduction

This technical support document (TSD) presents analysis the United States Environmental Protection Agency (EPA) performed to support its response to petitions to reconsider the Clean Air Interstate Rule (CAIR) (70 FR 25162) on the grounds that EPA did not provide adequate notice that fuel factors might be used and of the calculation procedures that would be used to determine these specific factors. (The complete response may be seen in the Reconsideration Notice of Proposed Rule (NPR).) EPA conducted additional analysis to further explain the impact of these factors on State annual NOx budgets. This analysis demonstrates that the factors selected are reasonable and decrease the disparity between most States' projected electric generation unit (EGU) emissions and Statewide NOx budgets.

The CAIR establishes regional emission budgets for annual and seasonal NOx emissions. These regional budgets are then further divided into State budgets, with a share of each total regional budget allocated to each State in the corresponding CAIR region. For the CAIR NOx programs, each State participating in the trading programs will be able to allocate, to sources in the State, the number of NOx emission allowances in their budgets. Petitioners have challenged the methodology EPA used to establish these State budgets for annual and seasonal NOx.

The CAIR Supplemental Notice of Proposed Rule (SNPR) presented two potential methods of setting annual State budgets for NOx: the “heat input” approach and the “fuel factor” approach (or “adjusted heat input” approach). In the Final Rule, EPA chose the fuel factor approach, for both the annual NOx program and the seasonal NOx program.

Heat Input Approach

The heat input approach was proposed in the Notice of Proposed Rule (69 FR 4566). This approach apportioned to each State a Statewide annual NOx budget that was proportionate to that State’s share of regionwide average annual, baseline heat input. The average annual heat input was calculated using baseline heat input data from Acid Rain Program units for the years 1999 through 2002. EPA summed the average heat input from each of the applicable States to obtain a regional total average annual heat input. Each State received a pro rata share of the regional NOx emissions budget based on the ratio of its average annual heat input to the regional total average annual heat input.

In the SNPR, EPA proposed to revise its determination of State annual NOx budgets by supplementing the data with annual heat input data from the Energy Information Agency (EIA), for the non-Acid Rain units (69 FR 32684). The Notice of Data Availability (NODA) included State NOx budgets using the heat input approach, for the relevant CAIR region at that time.

Fuel Factor Approach:

The fuel factors approach begins with the same average annual, baseline heat input data used in "heat input" approach described above, but adjusts these heat input averages by multiplying them by fuel-specific factors. These factors are 1.0 for coal-fired units, 0.4 for gas-fired units, and 0.6 for oil-fired units and are based upon the relative differences in the average NOx emission rate for each fuel type (e.g., natural gas-fired units have an average NOx emission rate that is about 40 percent of the average rate for coal-fired generation). These NOx emission rates for each fossil fuel were derived by totaling 1999 through 2002 average heat input and emissions for each fuel type, in each State.

Additional Discussion of Analysis Presented in NPR Preamble

The Reconsideration NPR presents two EPA analyses: one on a regionwide scale and the second on a State-by-State level. The regionwide analysis compared, by the type of fuel combusted (i.e., coal-fired and gas-fired and other non-coal-fired generation), the regionwide emissions and allowance budgets. The results demonstrated that, under either approach (i.e., simple heat input or fuel factor approach): natural gas-fired and other non-coal-fired generation account for more allowances in the resulting NOx budgets than their projected emissions in both 2009 and 2015; and States with relatively more units of this type receive a greater share of the regionwide budget. However, using the fuel factor approach, reduces the disparity between the number of allowances provided and the projected emissions than the simple heat input method.

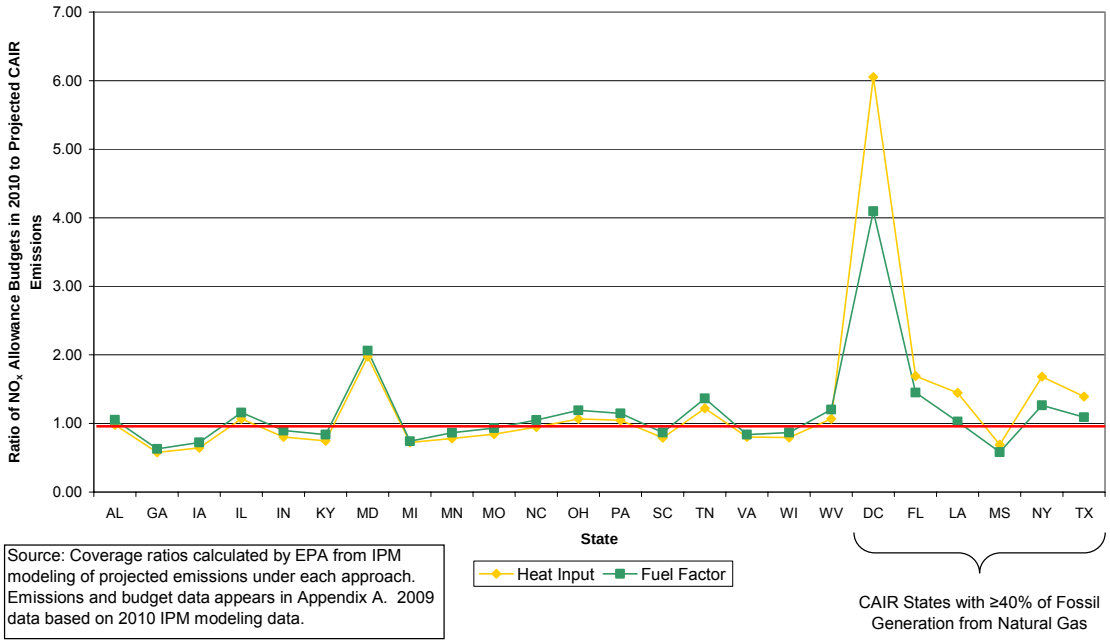
The State-by-State analysis presented in the Reconsideration NPR compares the Statewide projected emissions and the CAIR NOx budget for each scenario (i.e., CAIR and Base Case) in the years 2009 and 2015. The analysis shows that, under CAIR, States receiving fewer allowances using a fuel factor approach (i.e., DC, FL, LA, MS, NY, and TX) generally still receive Statewide budgets that are greater than their projected emissions in 2009 and 2015. This results because a substantial portion of their generation portfolio consists of gas-fired sources with generally low NOx emission levels. These States, in most cases, would still have excess allowances. States that receive larger budgets, under CAIR and using the fuel factor method, are generally States with a large amount of coal-fired generation that are installing and operating year round most of the post combustion NOx controls that result from CAIR.

Additional Analysis to Compare Statewide Budgets and Emissions

EPA conducted additional analysis, not presented in the Reconsideration NPR, to compare the annual, Statewide NOx budgets and the projected annual NOx emissions by examining the fraction of the projected emissions that would be covered by the budgets using both NOx allowance apportionment approaches (i.e., simple heat input and fuel factor approaches). Figures 1 and 2 present the distribution of this coverage ratio for the 2009 and 2015 for projected emissions under CAIR and illustrate that, by following generally the same trend, the heat input and fuel factor approaches result in similar patterns of State budgets relative to projected emissions. Where the results of the two

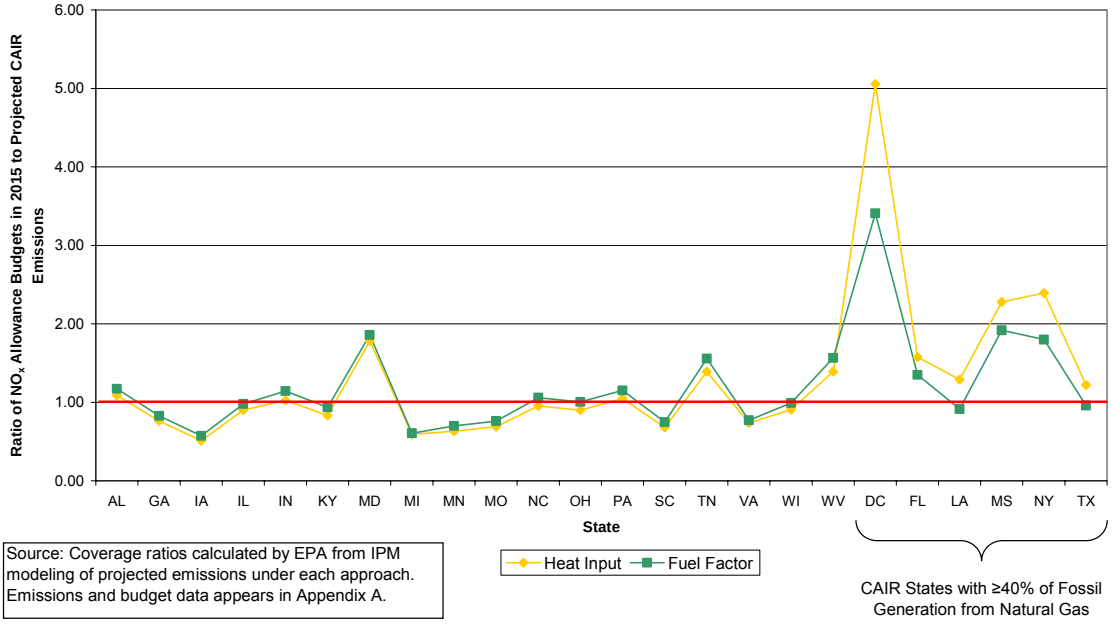
methodologies diverge, the fuel factor approach is generally mitigating disparity between the States' projected emissions and its Statewide budgets for 2009 and 2015.

Figure 1: Ratio of State NO_x Allowance Budgets to CAIR Emissions in 2009 under Heat Input and Fuel Factor Approaches



Source: Coverage ratios calculated by EPA from IPM modeling of projected emissions under each approach. Emissions and budget data appears in Appendix A. 2009 data based on 2010 IPM modeling data.

Figure 2: Ratio of State NO_x Allowance Budgets to CAIR Emissions in 2015 under Heat Input and Fuel Factor Approaches



Source: Coverage ratios calculated by EPA from IPM modeling of projected emissions under each approach. Emissions and budget data appears in Appendix A.

To quantitatively evaluate whether the fuel factor approach is providing States with annual NOx budgets that more closely reflected their projected emissions, EPA calculated the arithmetic mean of the (absolute) difference between a States coverage ratio and 1.0 (i.e., the value representing a State's projected emissions matching the State's CAIR NOx budget). In other words, EPA calculated how far off the State's coverage ratio was from 1.0, and then averaged these values for each approach. Under CAIR, the resulting average differences were 0.16 and 0.24 for the fuel factor and the simple heat input approaches, respectively, in 2009. In 2015, the resulting average differences under CAIR were 0.20 and 0.28 for the fuel factor and the simple heat input approaches, respectively. Therefore, using the fuel factor approach for CAIR, there is less overall disparity between the amount of allowances a State will receive and its projected emissions.

Further examination of Figures 1 and 2 show that, in general, the States with predominately coal-fired generation have coverage ratios that are somewhat greater under the fuel factor approach (i.e., they receive more allowances under the fuel factor approach). In predominantly coal-fired generation States with coverage ratios greater than 1.0 in both 2009 and 2015 (i.e., MD, NC, OH, PA, TN, and WV), there is a very large percentage of their coal-fired generation that will install and operate year round with advanced NOx emission controls (i.e., select catalytic reduction or select non-catalytic reduction) generally as a result of CAIR.[1] In addition, those predominately coal-fired States with larger coverage ratios (i.e., MD in 2009 and MD, TN, and WV in 2015) have relatively low projected annual NOx emission rates under CAIR, indicating that their coal-fired generation is using advanced NOx control equipment.[2] Conversely, most of those States that are not dominated by coal-fired generation (i.e., DC, FL, LA, NY, and TX) have coverage ratios that are slightly less, but still greater than 1.0, under the fuel factor approach. This illustrates how, in general, the fuel factor approach tends to give more allowances to those States expected to make investments in control technologies (i.e., the predominantly coal-fired generation States) and less (but sufficient) allowances to those States that rely upon fossil fuel-fired generation other than coal.

[1] The percentage of coal-fired generation with advanced NOx controls within these States for 2009 and 2015, respectively is: for MD, 94 and 97 percent; for NC, 88 and 89 percent; for OH, 79 and 82 percent; for PA, 75 and 85 percent; for TN, 67 and 78 percent; and for WV, 82 and 96 percent. This is based upon EPA calculations using IPM modeling (EPA219b_BART_13_2010 and EPA219b_BART_13_2015) for the multipollutant analysis of CAIR, the Clean Air Mercury Rule, and the Clean Air Visibility Rule. This analysis can be found in docket (OAR-2003-0053) as "State-by-State Projected Retrofits under Clean Air Rules."

[2] The NOx emission rate under CAIR for MD is 0.078 lbs/mmBtu in 2010. In 2015, under CAIR, the NOx emission rate for MD, TN, and WV is 0.067, 0.093, and 0.073, respectively. The CAIR regionwide average is 0.14 and 0.11 lbs/mmBtu in 2010 and 2015, respectively. The source is EPA calculations from IPM modeling (EPA219b_BART_13_2010 and EPA219b_BART_13_2015) for the multipollutant analysis of CAIR, the Clean Air Mercury Rule, and the Clean Air Visibility Rule. This analysis can be found in docket (OAR-2003-0053) as "State-by-State Projected Annual NOx Emission Rates under Clean Air Rules."

Table 1: State-by-State NOx Budget Coverage Ratios*

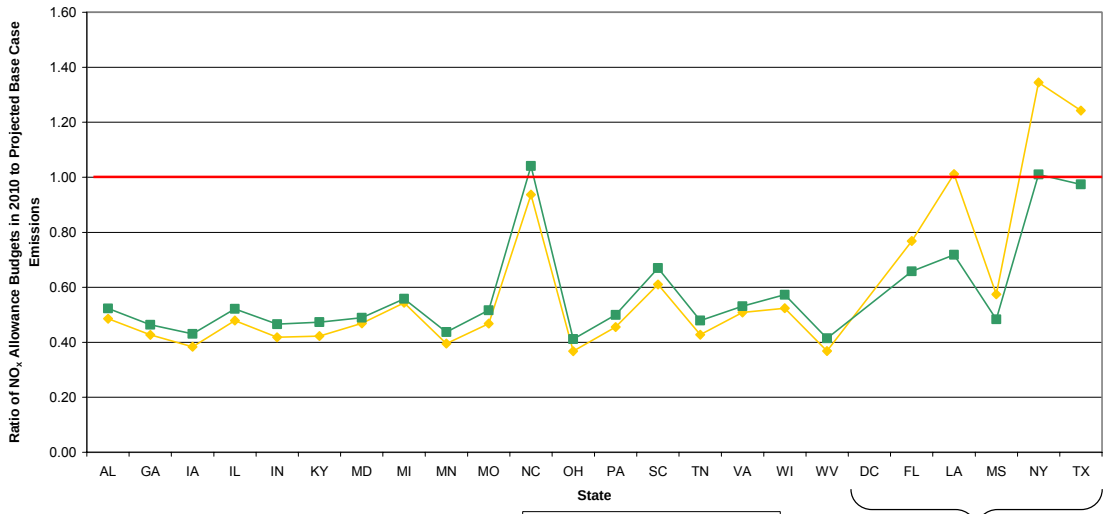
CAIR State	2009**				2015			
	Base Case		CAIR		Base Case		CAIR	
	Heat Input	Fuel Factor	Heat Input	Fuel Factor	Heat Input	Fuel Factor	Heat Input	Fuel Factor
AL	0.49	0.52	0.98	1.05	0.40	0.43	1.09	1.17
GA	0.43	0.46	0.58	0.63	0.36	0.39	0.76	0.83
IA	0.38	0.43	0.65	0.72	0.30	0.34	0.51	0.57
IL	0.48	0.52	1.07	1.16	0.37	0.40	0.90	0.98
IN	0.42	0.47	0.80	0.90	0.35	0.39	1.03	1.14
KY	0.42	0.47	0.75	0.84	0.35	0.39	0.83	0.93
MD	0.47	0.49	1.97	2.06	0.39	0.40	1.78	1.86
MI	0.54	0.56	0.72	0.74	0.44	0.45	0.59	0.61
MN	0.40	0.44	0.78	0.86	0.32	0.35	0.63	0.70
MO	0.47	0.52	0.85	0.93	0.38	0.42	0.69	0.76
NC	0.94	1.04	0.95	1.05	0.76	0.85	0.95	1.06
OH	0.37	0.41	1.06	1.19	0.29	0.33	0.90	1.01
PA	0.46	0.50	1.05	1.15	0.39	0.43	1.05	1.15
SC	0.61	0.67	0.79	0.87	0.49	0.54	0.68	0.75
TN	0.43	0.48	1.22	1.37	0.36	0.40	1.39	1.56
VA	0.51	0.53	0.80	0.84	0.48	0.50	0.74	0.77
WI	0.52	0.57	0.79	0.87	0.45	0.49	0.91	0.99
WV	0.37	0.41	1.07	1.20	0.31	0.35	1.39	1.56
DC***	na	na	6.05	4.10	5.06	3.41	5.06	3.41
FL	0.77	0.66	1.69	1.45	0.64	0.55	1.58	1.35
LA	1.01	0.72	1.45	1.03	0.83	0.59	1.29	0.92
MS	0.57	0.48	0.69	0.58	0.47	0.40	2.28	1.92
NY	1.34	1.01	1.68	1.26	1.15	0.86	2.39	1.80
TX	1.24	0.97	1.39	1.09	1.07	0.84	1.22	0.96

* The NOx budget coverage ratio is the ratio of the IPM projected emissions divided by the CAIR Statewide budget.
** 2009 values are based upon 2010 projections.
*** DC is projected to have no emissions in 2009.
Source: EPA calculations based upon IPM modeling. See Appendix A for data.

In addition to examining the potential impacts of using the fuel factor approach under a CAIR scenario, EPA also calculated the coverage ratios for a Base Case scenario (i.e., a scenario where only existing regulatory programs are implemented). Table 1 lists the coverage ratios under CAIR and Base Case scenarios for each State. The ratio of the State NOx budgets to the CAIR projected emissions shows the State-by-State, relative differences of the allowances the State will receive versus the emissions projected to occur with the CAIR controls in place. The ratio of the State NOx budgets to the projected Base Case emissions shows State-by-State relative differences in the levels of NOx reductions for which the States are accountable – through the installation of NOx controls or purchasing allowances. The ratio provides a sense of the level of the compliance costs for generation units in each State will face and how, through both the installation of NOx controls and the purchase of allowances, the costs of compliance are likely to be distributed among the States.

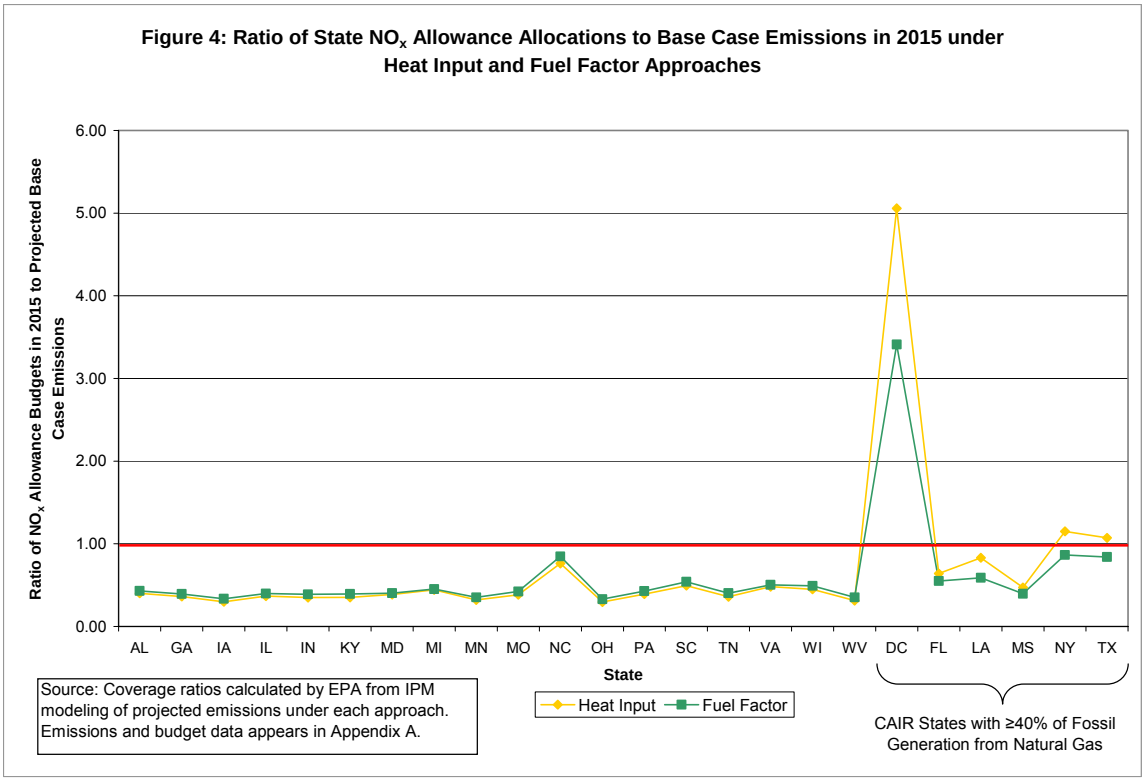
Figures 3 and 4 present the distribution of these coverage ratios of State NOx budgets to the projected Base Case emissions for the 2009 and 2015 and illustrate that, similar to the coverage ratios reflecting projected CAIR emissions, that the coverage ratios reflecting Base Case emissions for the fuel factor and heat input approaches generally follow the same trend. For States with predominantly coal-fired sources, the coverage ratios are well below 1.0, indicating that their Statewide budgets are below their projected Base Case emissions and they will be required to make emission reductions under CAIR. The fuel factor approach provides somewhat greater Statewide budgets to these predominantly coal-fired States that are making investments in emission controls. Figures 3 and 4 show how the fuel factor approach serves to generally flatten the distribution of coverage ratios and more evenly spread the responsibility for NOx emission reduction among the States.[3]

Figure 3: Ratio of State NO_x Allowance Budgets to Base Case Emissions in 2009 under Heat Input and Fuel Factor Approaches



Note: DC has no projected Nox emissions and no coverage factor.
Source: Coverage ratios calculated by EPA from IPM modeling of projected emissions under each approach. Emissions and budget data appears in Appendix A. 2009 data based on 2010 IPM modeling data.

[3] While using the fuel factor approach generally flattens the distribution, the NC coverage ratio is unusually large because existing State NOx emission reduction requirements included in IPM modeling are comparable to CAIR. For DC, IPM modeling projects zero NOx emissions in 2010. While the DC coverage ratio in 2015 does flatten under the fuel factor approach, the ratio is unusually large because DC has a small amount of gas-fired capacity that is used intermittently.



Ozone Season NOx allowances

The analysis above pertains to the CAIR annual NOx budgets. A similar fuel-adjustment factor methodology was used in establishing the CAIR seasonal NOx budgets, using data on historic heat input and fuel use for the ozone season rather than for a full year. In addition, a somewhat different subset of States is covered under the ozone season.

EPA modeling indicates that the ozone season program is expected to act as a backstop, with the annual NOx program being the binding cap that influences sources decisions to control emissions. As a result, EPA did not conduct a similar fuel factor vs. heat input approach analysis for the CAIR NOx ozone season program and does not propose to change the use of a consistent State budget apportionment approach for both CAIR NOx programs.

Delaware and New Jersey Statewide Budget Approach

EPA proposed that Delaware and New Jersey also would be affected by CAIR for PM2.5 in a rulemaking published as CAIR was finalized. Under this separate rule, Delaware and New Jersey would receive separate annual NOx Statewide budgets, totaling just over 14,000 tons. These separate State budgets would not impact the existing regional budget. The Reconsideration NPR presented analysis of the Delaware and New Jersey budgets similar to that conducted for States affected by CAIR PM2.5 findings (i.e., affected by

the CAIR annual NOx program). This compared the projected emissions in 2009 and 2015 to the Statewide budgets for both approaches. The coverage ratios for both DE and NJ are similar under each approach. Table 2 lists the coverage ratios under CAIR and Base Case scenarios for each State. The difference between the two NOx budget apportionment approaches is not large.

Table 2: Statewide NOx Budget Coverage Ratios for DE and NJ

CAIR State	2009*				2015			
	Base Case		CAIR		Base Case		CAIR	
	Heat Input	Fuel Factor	Heat Input	Fuel Factor	Heat Input	Fuel Factor	Heat Input	Fuel Factor
DE	0.80	0.76	1.11	1.05	0.62	0.59	0.87	0.82
NJ	0.36	0.44	0.40	0.49	0.27	0.33	0.30	0.36

* 2009 values are based upon 2010 projections.
The NOx budget coverage ratio is the ratio of the IPM projected emissions divided by the CAIR Statewide budget.
Source: EPA calculations based upon IPM modeling. See Appendix A for data.

Sensitivity of Analysis to Higher Electricity Demand and Gas and Oil Prices

EPA conducted an analysis using EIA's forecast of higher electricity demand and gas and oil prices. To do this, EPA used IPM to model a scenario that simulated these conditions. This model run resulted in projected emissions and coverage ratios very similar to the CAIR analysis using EPA modeling assumptions (as presented above in this TSD), showing that EPA's above analysis is robust enough to support the fuel adjusted heat input approach finalized in CAIR, even assuming some uncertainty about future electricity demand and natural gas prices. Table 3 shows the projected emissions and associated coverage ratios for the sensitivity analysis.

Table 3 : State-by-State Annual NOx Budgets and Emissions for IPM Using EIA Forecasts

	2009 Annual NOx Budgets (tons)		Projected 2009 Emissions (tons)			EIA Forecast Coverage Ratios		EPA Assumptions Coverage Ratios	
CAIR State	Heat Input	Fuel Factor	Coal	Other	Total	Heat Input	Fuel Factor	Heat Input	Fuel Factor
AL	64,153	69,020	54,463	2,481	56,944	1.13	1.21	0.98	1.05
GA	61,104	66,321	86,477	2,874	89,352	0.68	0.74	0.58	0.63
IA	29,114	32,692	51,071	90	51,162	0.57	0.64	0.65	0.72
IL	70,101	76,230	63,542	4,389	67,931	1.03	1.12	1.07	1.16
IN	97,761	108,935	125,605	965	126,570	0.77	0.86	0.80	0.90
KY	74,216	83,205	102,973	318	103,291	0.72	0.81	0.75	0.84
MD	26,548	27,724	12,030	1,564	13,594	1.95	2.04	1.97	2.06
MI	63,630	65,304	89,833	821	90,654	0.70	0.72	0.72	0.74
MN	28,449	31,443	39,020	234	39,255	0.72	0.80	0.78	0.86
MO	54,288	59,871	66,690	387	67,076	0.81	0.89	0.85	0.93
NC	55,985	62,183	60,006	537	60,543	0.92	1.03	0.95	1.05
OH	97,051	108,667	99,841	1,130	100,970	0.96	1.08	1.06	1.19
PA	90,383	99,049	86,211	1,939	88,150	1.03	1.12	1.05	1.15
SC	29,778	32,662	34,954	1,201	36,155	0.82	0.90	0.79	0.87
TN	45,503	50,973	39,746	30	39,777	1.14	1.28	1.22	1.37
VA	34,510	36,074	43,171	3,602	46,773	0.74	0.77	0.80	0.84
WI	37,255	40,759	53,055	734	53,790	0.69	0.76	0.79	0.87
WV	65,933	74,220	48,348	3	48,351	1.36	1.54	1.07	1.20
DC	213	144	0	35	35	6.05	4.10	6.05	4.10
FL	116,044	99,445	59,120	20,346	79,465	1.46	1.25	1.69	1.45
LA	50,032	35,512	30,348	2,028	32,376	1.55	1.10	1.45	1.03
MS	21,152	17,807	29,619	1,440	31,058	0.68	0.57	0.69	0.58
NY	60,709	45,617	31,723	8,712	40,434	1.50	1.13	1.68	1.26
TX	230,960	181,014	125,824	41,270	167,094	1.38	1.08	1.39	1.09
Total	1,504,872	1,504,873	1,151,245	86,296	1,237,541				

* 2009 values are based upon 2010 projections.

The NOx budget coverage ratio is the ratio of the IPM projected emissions divided by the CAIR Statewide budget.

Source: EPA calculations based upon IPM modeling run (CAIR_CAMR_CAVR_EIA_2010).

Appendix A

Table A1: Comparison of Projected NO_x Emissions and State Budgets for CAIR States (thousand tons)

State	Projected 2009* Emissions and Budgets					Projected 2015 Emissions and Budgets				
	Emissions		Budget			Emissions		Budget		
	Base Case	CAIR	Heat Input	Fuel Factor Adjusted	Percent Change	Base Case	CAIR	Heat Input	Fuel Factor Adjusted	Percent Change
DC**	0	<1	<1	<1	-32%	<1	<1	<1	<1	-33%
LA	49	35	50	36	-29%	50	32	42	30	-29%
NY	45	36	61	46	-25%	44	21	51	38	-25%
TX	186	166	231	181	-22%	179	157	192	151	-22%
MS	37	31	21	18	-16%	37	8	18	15	-16%
FL	151	69	116	99	-14%	151	61	97	83	-14%
MI	117	88	64	65	3%	120	90	53	54	3%
MD	57	13	27	28	4%	57	12	22	23	4%
VA	68	43	35	36	5%	60	39	29	30	5%
AL	132	65	64	69	8%	134	49	53	58	8%
GA	143	106	61	66	9%	141	67	51	55	9%
IL	146	66	70	76	9%	159	65	58	64	9%
WI	71	47	37	41	9%	69	34	31	34	9%
PA	198	86	90	99	10%	193	72	75	83	10%
SC	49	38	30	33	10%	50	36	25	27	10%
MO	116	64	54	60	10%	118	66	45	50	10%
MN	72	36	28	31	11%	74	37	24	26	11%
NC	60	59	56	62	11%	61	49	47	52	11%
IN	234	121	98	109	11%	233	79	81	91	11%
OH	264	91	97	109	12%	274	90	81	91	12%
TN	106	37	46	51	12%	106	27	38	42	12%
KY	176	99	74	83	12%	176	74	62	69	12%
IA	76	45	29	33	12%	81	47	24	27	12%
WV	179	62	66	74	13%	176	40	55	62	13%
Total	2732	1503	1505	1505	0%	2746	1254	1254	1254	0%

*2009 values are based on 2010 IPM projections.
**For DC: Projected **Base Case emissions are 35 tons in 2015. CAIR Emissions are projected to be 35 tons in both 2009 and 2015. Simple Heat Input budgets are 213 and 178 tons in 2009 and 2015, respectively. Fuel Factor budgets are 144 and 120 tons in 2009 and 2015, respectively.
Source: Emission projections are based upon IPM model run "CAIR_CAMR_CAVR_PARSED_2010" and "CAIR_CAMR_CAVR_PARSED_2015." Annual CAIR NOx budgets are final CAIR NOx budgets.

Appendix A
(continued)

Table A2: Comparison of Projected NOx Emissions and State Budgets for New Jersey and Delaware (thousand tons)

	Projected 2009* Emissions and Allowance Allocation					Projected 2015 Emissions and Allowance Allocation				
Proposed CAIR State	**Base Case Emissions**	**CAIR Emissions**	**Proposed Heat Input Budget**	**Proposed Fuel Factor Budget**	**Percent Change**	**Base Case Emissions**	**CAIR Emissions**	**Proposed Heat Input Budget**	**Proposed Fuel Factor Budget**	**Percent Change**
NJ	16.8	12.0	13.4	12.7	-5.6%	17.9	12.8	11.2	10.6	-5.6%
DE	9.4	8.5	3.4	4.2	22.1%	10.7	9.5	2.8	3.5	22.2%

*2009 values are based on 2010 IPM projections.
**For DC: Projected **Base Case emissions are 35 tons in 2015. CAIR Emissions are projected to be 35 tons in both 2009 and 2015. Simple Heat Input budgets are 213 and 178 tons in 2009 and 2015, respectively. Fuel Factor budgets are 144 and 120 tons in 2009 and 2015, respectively.
Source: Emission projections are based upon IPM model run "CAIR_CAMR_CAVR_PARSED_2010" and "CAIR_CAMR_CAVR_PARSED_2015." Proposed, annual CAIR NOx budgets are budgets proposed in DE/NJ NPR.